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# Moving Map Composer: A Tool For Consolidating Tasks Associated With The Design, Creation, And Management Of Digital Aeronautical Chart Products For Navy Aircraft

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## ABSTRACT

Scientists from the Naval Research Laboratory at the Stennis Space Center (NRLSSC) have developed a software tool called the Moving Map Composer<sup>1</sup> (MMC) to help Navy aircrew design and build mission-specific, digital aeronautical chart coverages for use in mission planning systems and in-flight moving-map displays. MMC can also be used to edit and incorporate other sources of information – such as digitized emergency checklist procedures – into these mission-specific chart coverage files. MMC is comprised of a series of Graphical User Interfaces (GUI) and low-level C language applications that simplify complex tasks such as data fusion, chart design, editing, and file management. This paper provides a functional overview of MMC and its applications. Design issues that were encountered and solutions devised during the course of product development are also addressed.

**Keywords:** Digital Aeronautical Charts, Coverage Files, Mission Planning, Data Management, and Graphical User Interfaces.

## 1. INTRODUCTION

Navy aviators require current, accurate, and readily accessible digital chart data to drive aircraft moving-map displays and provide enhanced situational awareness in the cockpit. In support of this requirement, NRLSSC scientists have developed the MMC software system to help aircrew design and build mission-specific, digital aeronautical chart coverages for use in mission planning systems and in-flight moving-map displays. Aircrew can also use MMC to edit and incorporate other sources of information such as reconnaissance photographs and digitized emergency checklist procedures into these mission-specific coverage files. MMC was created in support of the Naval Air Systems Command F/A-18 Hornet and AV-8B Harrier Programs.

MMC is comprised of a series of GUIs and low-level C language applications that simplify complex tasks such as data fusion, chart design, editing, and file management. MMC has been revised and updated several times in response to changing Fleet requirements and is utilized by both U.S. and foreign militaries, including Spain, Italy and Finland. MMC users continue to provide feedback and requests for additional capabilities and enhancements, many of which have been incorporated into MMC. The most recent version of the software provides capabilities for paper chart scanning, which involved development of GUIs and tools to view scanned data, obtain datum and ellipsoid values, acquire geographic coordinate control points to geo-reference scanned images, clip scanned images, and merge scanned data with existing digital chart products. These capabilities simplify and streamline many of the previously tedious and labor-intensive tasks associated with chart scanning. The newest release of MMC also provides a checklist manager that allows users to easily manage the many files associated with sets of digitized emergency checklist procedures, visualize an entire checklist set within a relative context, and edit individual checklists.

While MMC functionality is driven by the needs of users in the Fleet, GUI design and development is driven by the challenge to create human-computer interfaces that streamline operational tasks and incorporate intuitive approaches and logical methodologies.

## 2. FUNCTIONALITY

MMC provides the means to incorporate various data sources to produce digital aeronautical chart products. These sources include standard products from the National Imagery and Mapping Agency (NIMA), such as Compressed Aeronautical Charts (CAC)<sup>2</sup>, Digital Terrain Elevation Data (DTED)<sup>3</sup>, and scanned paper charts. Figure 1 is a simplified diagram of the principal MMC software operations, where the user inputs primary data sources from which Mission Planning

System (MPS) data and Aircraft Optical Disk (AOD) images are created, processed and archived. These data sets can be augmented with ancillary data such as reconnaissance photographs and digitized emergency checklist procedures. The most common products created by MMC are "compositions" of chart data for user-defined geographic areas. Compositions are saved as a series of bitmaps (one per contiguous area, latitudinal zone, and chart scale) where one bit in the bitmap represents one tile of geospatial data or the equivalent of a 2"x2" portion of paper chart (figure 2).

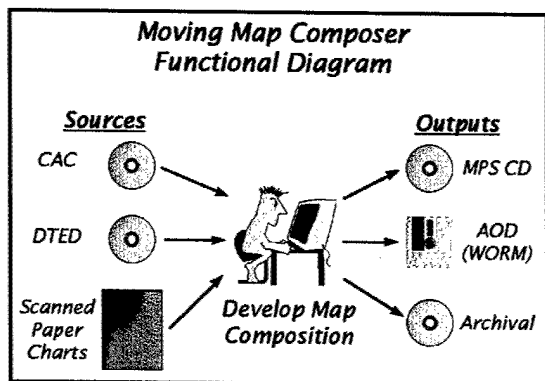


Figure 1. Primary MMC functions

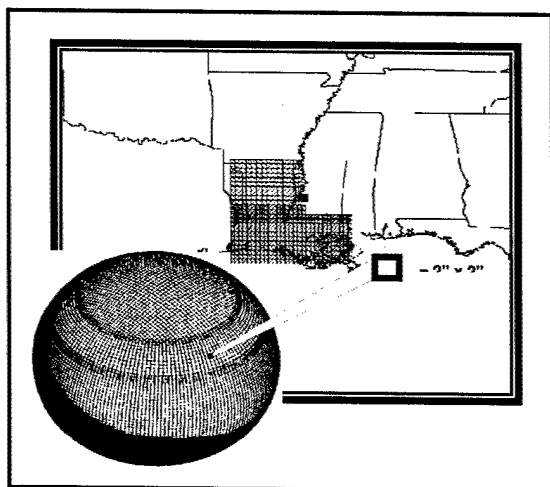


Figure 2. Compositions are saved as series of bitmaps where one bit represents one tile of spatial data

A composition is considered complete when it contains chart data for all of the desired areas of coverage, at selected scale(s) and any (optional) ancillary information. MMC uses this complete (i.e., *final*) composition to create AOD images that are written to ruggedized Write-Once Read Many (WORM) media for cockpit use and to create MPS images written to CD for use in Mission Planning Stations. Figure 3 provides an example of an AOD image with mission overlays in a cockpit moving-map display.

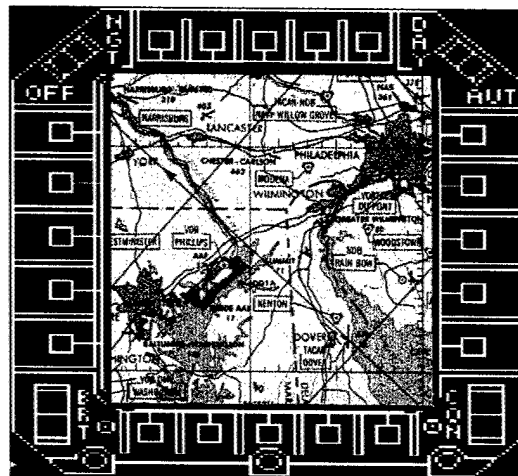


Figure 3. An AOD image as shown in an aircraft cockpit moving-map display.

MMC handles all file management through menu options and task-oriented GUIs. The largest portion of the Main MMC window (figure 4) is a world map that serves as a base for designing AOD and MPS compositions. Tools exist that allow the user to define geographic regions, or areas of coverage, on which AOD or MPS map compositions are based. MMC also provides tools for zooming in and out of areas, specifying areas, and setting map projection, chart series and scale.

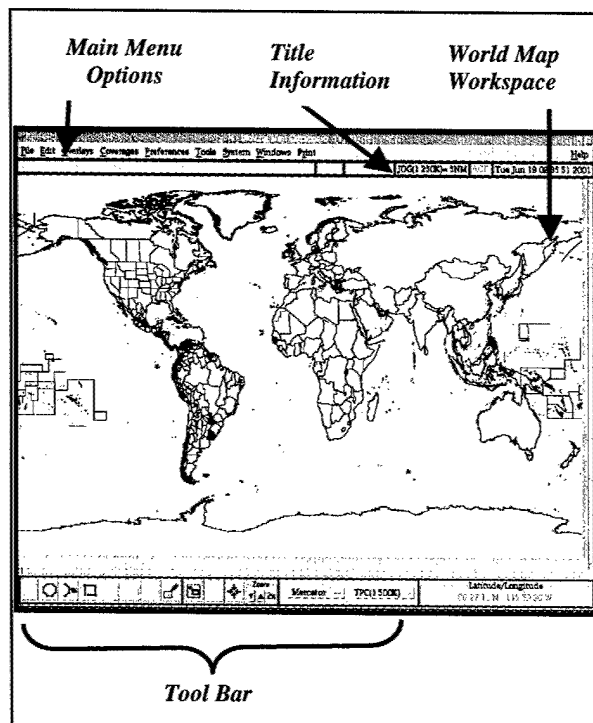


Figure 4. Main MMC window

Through main menu options, MMC employs a series of GUIs and applications to simplify and perform complex tasks including data fusion, chart design, editing, and file management. Moreover, MMC follows standard PC Windows application conventions to achieve a familiar look and feel. For example, the File Menu has options for creating new compositions, opening working and final compositions, and saving working compositions. The user is free to create descriptive file names. Directory location and file placement is handled by MMC. Similarly, the Edit Menu has options to Cut, Copy, Paste, Undo, and Select/UnSelect coverages.

### 3. DESIGN AND DEVELOPMENT

MMC has been revised and updated several times in response to changing Fleet needs. For example, the recent MMC revision (version 3.5) addressed the need to simplify emergency checklist procedure editing and file management. Since development and implementation of these tools exemplify the challenges that were faced in previous upgrades of MMC, the emergency checklist procedure enhancement is described in further detail in this paper.

Emergency checklist procedures can be used to augment chart data written onto AODs and MPS CDs. Fleet users required the means to facilitate and streamline the common checklist management tasks. At times, these tasks could become quite tedious and time-consuming. Users maintain many different checklist sets and a single checklist set may contain up to 256 separate files; there may be as many as 16 different categories each of which can contain 16 pages (figure 4).

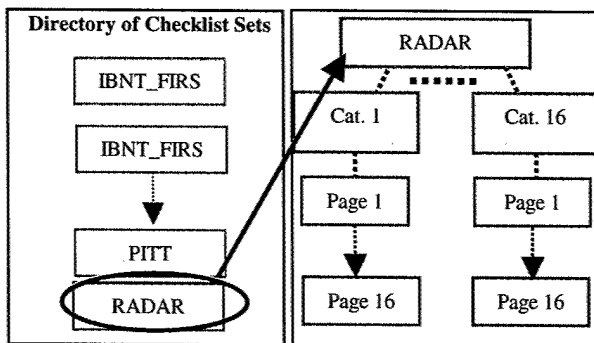


Figure 4. All Checklist sets are stored in one directory. Each Checklist set may include up to 256 files

Common checklist operations that were streamlined for MMC version 3.5 include selecting checklist sets, deleting categories and pages, inserting new categories and pages, rearranging categories and pages, modifying

checklist titles, modifying page text, and creating new checklist sets. Existing GUI designs and programming logic were used to improve these operations, when possible. MMC is built with a library of GUI designs and methodologies that NRLSSC has developed to accomplish both generic and specialized tasks. For example, existing file management GUIs and tools were expanded to include checklist files, providing users with a familiar and easy means of selecting entire checklist sets for editing, and renaming (figure 5). The user simply double-clicks on the name of a desired checklist set to select it for modification. With this GUI, an entire checklist set is selected, with all of its associated files identified and made available for use.

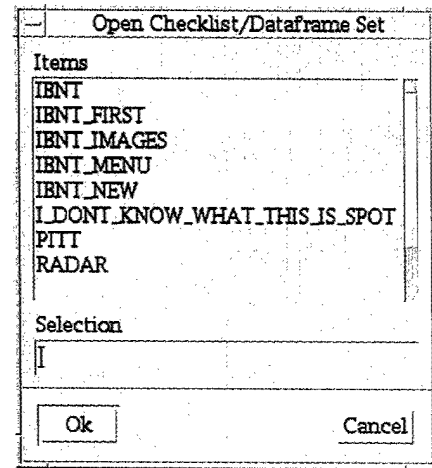


Figure 5. Checklist set selection GUI

Some of these operational tasks required development of new methods based on the same intuitive approaches used in the development of previous MMC versions. These tasks were translated into their corresponding common counterparts, as shown in table 1.

| Checklist Operational Task                   | Common Task   |
|--|---------------|
| Category and Page deletion                   | Cut (Delete)  |
| Insertion of additional Categories and Pages | Add, Paste    |
| Category and Page rearrangement              | Drag and Drop |
| Title modifications                          | Cut and Paste |
| Page text modifications                      | Text Editing  |

Table 1. Common operational tasks

The *Category Manager* GUI was designed to implement these tasks for managing and editing checklist sets (figure 6) within a relative context. *Category Manager* is comprised of four areas: a menu and options area, a checklist set name area, a text box

area containing editable category titles, and an area showing the map display image. The option area contains buttons to Copy, Paste, Undo, Add, and Delete entire categories (and their associated pages) within the checklist set. Each category is represented in ascending order by number and title (contained in a text box). The center of the *Category Manager* displays a static graphic image for this checklist that will be displayed on the cockpit moving map system. This image contains all of the category titles (as they appear in their associated title boxes) for this Checklist set. All modifications are reflected in this image.

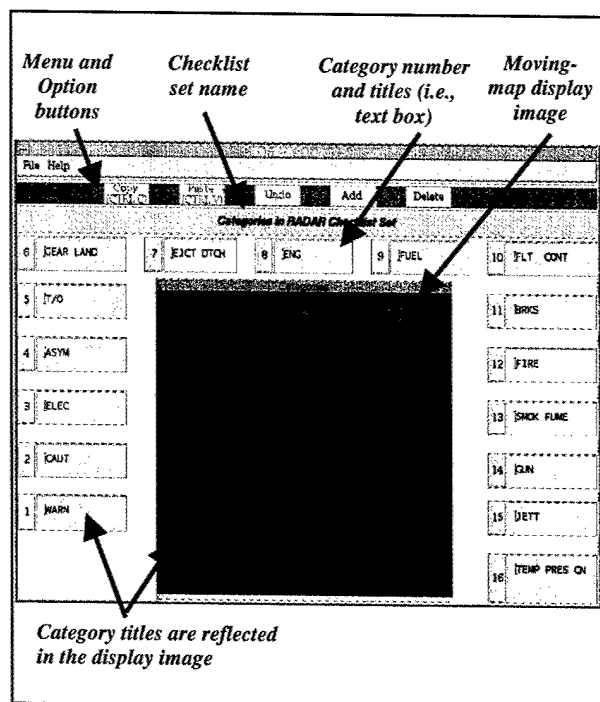


Figure 6. Checklist Manager showing categories in the RADAR checklist set. Category titles are edited in text boxes and shown in the moving-map display image.

Categories are selected for operation (e.g., copy, delete, etc.) by clicking directly on their sequence number. Users may re-arrange the order of categories via drag and drop operations. Clicking on the current text box and typing new text renames a category. All modifications are reflected in the display area so the user can view the result (what you see is what you get).

The *Page Manager* is functionally similar to the *Category Manager* and also allows text editing of the checklist procedures contained within each page. Double-clicking on the desired category invokes the *Page Manager* (figure 7). Pages are selected for operation by clicking directly on their sequence number. The center display shows the currently selected page. To invoke the editor (figure 8) for

editing the text within this page, the user double-clicks on the displayed image. The text editor also has options for modifying text size, and color. When edits are complete, the saved modifications are reflected in the page manager, letting the user view the result.

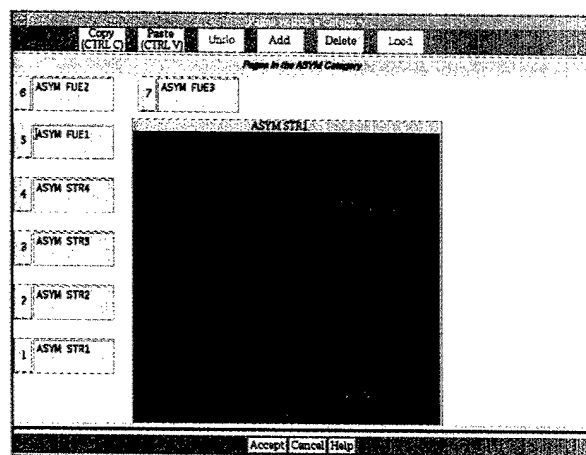


Figure 7. The Page Manager and pages associated with a specific category. The first page is selected and shown in the moving-map display area.

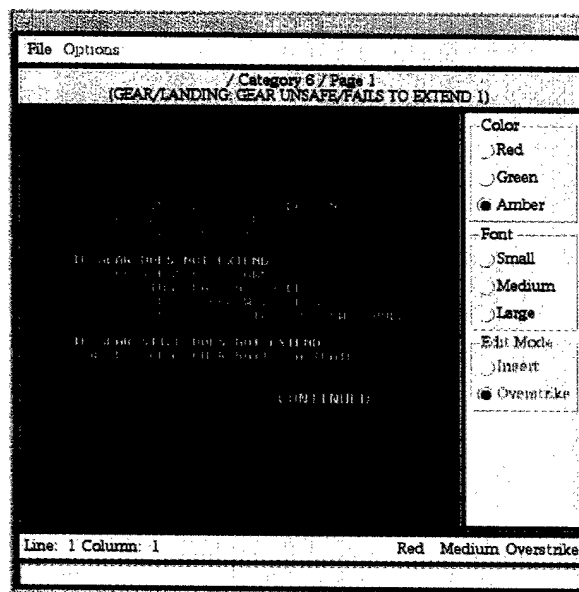


Figure 8. The page text editor

#### 4. SUMMARY

MMC functionality is driven by the needs of users in the Fleet. GUI design and development continues to be steered by the challenge to create human-computer interfaces that streamline operational tasks and incorporate intuitive approaches and logical methodologies. With the tools and functionality

provided by the *Category* and *Page Managers*, MMC users can more easily manage, modify and edit checklist sets. Other MMC version 3.5 enhancements, such as scanning paper charts, were developed using similar methodologies. Most of the time-consuming operations and tedious tasks have been streamlined and are now managed by MMC. MMC capabilities and enhancements will continue to be developed in response to user needs and changing fleet requirements.

## 5. ACKNOWLEDGEMENTS

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